on the upperside more than half an inch, and on the hinder end less than a quarter of an inch. The interior is entirely open, with a smooth surface; the outside has the same impressed wrinkles as the anchylosed part of the jaw on the exterior surface, but much smaller wrinkles on the interior, where the two branches are united to each other. Here the structure of the surface is finer, and the bone more delicate. As a part of this surface is broken off, I cannot ascertain the extent of the opening of the alveolar channel, which was on this side of the articular branch. The only particular character which I see here is the presence of a sharp edge on the lower border of the branch, beginning a little behind the alveole of the last tooth, and increasing in elevation behind.

Finally, comparing the known part of the animal with the lower jaw of *Zeuglodon*, there is no doubt that *Saurocetes* was an animal of much smaller size. Supposing that the broken tip of the lower jaw was 7–8 inches long, and the wanting end of the articular branches 5–6 inches, we may presume that the whole lower jaw had an extent of 30–32 inches; and in this case the whole skull may have been 38–40 inches or $3\frac{1}{2}$ feet long, *prœter propter*. If that is true, the whole animal (if it had the figure of a dolphin like *Pontoporia*) may have been 15–16 feet long, as we know from my description that the skull occupies one fifth part of the entire body; or if we judge from the elongated figure of the lumbar vertebræ of *Zeuglodon* that *Saurocetes* had an analogous configuration, its total length may have been no more than 20 feet.

VII.—*Observations on the Species of* Atax *parasitic upon our Freshwater Mussels.* By Emil Bessels*.

It is comparatively but a short time since the embryology of the Arthropoda received far less attention than this interesting branch of science really deserved; and yet, since the classical memoir of Weissmann upon the development of the Diptera, it may almost be said to have become a favourite study with zoologists. In the course of the last few years there have appeared a series of works upon this subject, such as Mecznikow's embryological studies on insects and Dohrn's on the embryonic development of *Asellus aquaticus*, whilst Kupffer subjected the folded lamina (*Faltenblatt*) discovered by Weissmann to a thorough examination. Claparède promises us, in a memoir hereafter to be mentioned, further contributions; and quite

* Translated by W. S. Dallas, F.L.S., from the 'Württembergische naturwissenschaftliche Jahreshefte,' 1869, pp. 146–152.

recently A. Brandt has studied the developmental history of the Libellulidæ and Hemiptera with special reference to the embryonal envelopes.

The Acaridæ, however, had not been taken up by any one in the manner required by the present state of science. For a considerable time I had taken pity upon these neglected creatures, and investigated the development of *Atax*, *Phytopus*, *Tetranychus telarius*, *Sarcoptes*, and some other forms. When I was on the point of publishing my results (I only waited for the beginning of May in order to fill up some deficiencies in the development of *Phytopus*), I was not a little surprised at finding in the last part of Siebold and Kölliker's 'Zeitschrift' a memoir by Claparède*, elaborated in his usual masterly manner, which rendered the publication of the developmental history of those species which I had investigated in common with Claparède almost superfluous, inasmuch as our results essentially agreed.

The development of *Atax ypsilophorus*, some points in which will be here indicated, was described in its broad features by P. J. van Beneden as early as the year 1848†. But precisely the most remarkable circumstances escaped that observer, otherwise so accurate; and this may be due to the fact that he probably made use of a different egg for the investigation of each stage of development. In a letter which I sent to Van Beneden at the beginning of September 1868, I mentioned, *en passant*, that the results which I had obtained with regard to the development of *Atax* could not be brought into accordance with his. In connexion with a memoir upon the spherical organ in the Amphipoda‡ (sent to press in November 1868), I mentioned the occurrence "of an embryonal envelope of extremely peculiar characters in the species of *Atax* from *Unio* and *Anodonta*," and also the amœboid cells found between this envelope and the embryo, which are called hæmamœbæ by Claparède.

As has already been stated, my results agree with Claparède's in all the principal points. In the observation of the formation of the blastoderm, however, I have been rather more fortunate than the above-named naturalist, who was unable to observe that process. How long after the deposition of the eggs the blastoderm makes its appearance, no one can

* Studien an Acariden, pp. 445–546.

† "Recherches sur l'Histoire naturelle et le Développement de l'*Atax ypsilophora*," Mémoires de l'Acad. Roy. de Belgique, tome xxiv.

‡ "Einige Worte über die Entwickelungsgeschichte und den morphologischen Werth der kügelförmigen Organe der Amphipoden," Jenaische Zeitschrift für Medicin und Naturwissenchaften, Bd. v. Hft. 1. p. 98.

say with certainty, inasmuch as the deposition itself cannot be observed. In eggs which were taken from the branchiæ of the *Unio* or *Anodonta*, and apparently had undergone no change after deposition, I usually detected the first traces of the blastoderm in from two to three days. It is formed insularly, as may be easily proved by opening an egg carefully in a solution of 1 per cent. of bichromate of potash. It is impossible to ascertain the process of formation by the direct observation of the uninjured egg, on account of the dark colour of the yelk.

After the blastoderm has grown round the whole of the yelk, the embryonal envelope which Claparède describes as the *deutovum* separates from it. This is produced in exactly the same manner as the larval membrane of the Crustacea, as observed by Van Beneden and myself in various species of *Gammarus**. Claparède was at first inclined to regard† this envelope as the homologue of the structure which in insects has received the unfortunate name of the "amnion;" but he soon gave up this comparison. I, on the other hand, regarded the membrane in question in the Mites as homologous with the larval membrane of the Crustacea, and the latter as homologous with the "insect-amnion," for which I have elsewhere proposed the better name of "protoderm."

Shortly after the formation of the embryonal envelope, we see, between it and the blastoderm, the first amœboid cells (*hæmamœbæ* of Claparède). In the memoir above cited I remarked that these cells "are blood-corpuscles of quite abnormal derivation." In using this expression I had the circumstance in my mind that they are formed from separated blastodermic cells, which, at the time of their production, are the sole cellular structures that we find in the egg. I did not then feel it necessary to say any thing more upon this point, as the publication of my original memoir was to be expected. I thought at first that the blood-corpuscles were all developed from separated blastodermic cells, and only afterwards, perhaps after the formation of the buccal orifice, passed through this into the embryo. As, however, I never saw any such migration of the cells, even after observing them for hours, I have given up this view, and now think that there is a further formative focus for them in the interior of the embryo.

My present opinion as to the hæmamœbæ is, that they really agree perfectly in form and behaviour with blood-corpuscles,

* E. van Beneden and E. Bessels, "Résumé d'un Mémoire sur le Mode de Formation du Blastoderme dans quelques groupes de Crustacés," Bull. Acad. Roy. Belg. 2e sér. xxv. p. 443.

† *Loc. cit.* p. 97.

but nevertheless cannot be regarded as blood-corpuscles. I see in them appurtenances of the embryonal envelope which Claparède denominates the *deutovum*. Whilst at the commencement of embryonal development of many insects a *cellular* envelope separates from the blastoderm, and in some crustacea a larval skin, which is usually *structureless*, in *Atax* a larviform structure first separates from the blastoderm, and shortly afterwards the contractile cells. This state of things, when regarded in this manner, furnishes an additional reason for regarding the embryonal envelope of *Atax* as the homologue of the protoderm of insects.

* * * * *

In the course of his memoir Claparède suggests the question whether Van Beneden has not perhaps fallen into an error in representing the parasites of *Anodonta* as derived from *Unio*, or whether the same animal is parasitic upon *Anodonta* in Belgium that lives in *Unio* at Geneva.

In an appendix to a letter sent by me to Van Beneden, which will be printed in the next number of the 'Bulletins de l'Académie de Belgique,' Van Beneden remarks that he actually took the *Atax* figured in his work above cited from the branchiæ of *Anodontæ*.

I will here briefly communicate a case of migration from one kind of mollusk to the other.

When I was making my investigations of the embryology of *Atax*, I wished not to have to procure fresh material constantly, and therefore placed some hundred specimens of *Anodonta cygnea*, obtained from Esslingen, in a large well-trough with water running through it. As I also desired to study the natural history of the parasites of *Unio*, in about three months afterwards I procured a number of *Uniones* from the Enz, near Pforzheim; and these I kept in a tub. But as my stock gradually increased, I placed them, in about a fortnight, in the same trough with the *Anodontæ*. About four weeks afterwards I perceived in an *Anodonta* the same species of *Atax* which I had previously detected only in *Uniones*; and from this time forward I frequently found *Anodontæ* which contained from three to four mites of the other species.

By the great number of individuals which passed through my hands, I was enabled to discover a beautiful but rare dimorphism. Whilst the mites which live chiefly in *Unio* possess five suckers on each side of the sexual orifice, those from *Anodonta* have from thirty to forty on each side. Moreover the two species are distinguished by their form and size, even on a superficial examination, so that any confusion between them is hardly to be suspected. But I found mites which, as far as

form and size were concerned, agreed perfectly with the parasites of *Anodonta*, but instead of the great number, had only six suckers on each side. Are these to be regarded as a distinct species? I think not. At any rate, we shall do better to regard this peculiarity as a case of atavism, especially as the two species are not widely distant. In any case the mite with five suckers on each side will have made its appearance earlier in the natural genealogical tree than that with from thirty to forty. But the form with six suckers is a reversion towards the primary form.

VIII.—*The Tertiary Shells of the Amazons Valley.* By Henry Woodward, F.G.S., F.Z.S., of the British Museum.

Of the great river-systems with which explorers have made us acquainted, that of the Amazons is perhaps the most remarkable, as it is also one of the largest in the world. The courses of nearly all the large rivers of our earth lie in a north and south direction; the Amazons, on the contrary, runs nearly west and east. Situated almost beneath the equator, it traverses the southern continent of America from the eastern slopes of the Andes to the North-Atlantic Ocean (nearly fifty degrees)—a distance, computed by its course, of upwards of 4000 miles. Twenty great rivers, all of which are navigable, contribute their waters to its stream, which, under various names, drains considerably more than two millions of square miles of country. It is 40 miles wide where it enters the sea, whilst at 400 miles up stream, to which distance the tide ascends, it is still more than a mile in width*.

The stratified sandstones and clays observable in this great valley were attributed by Gardner to the Cretaceous series; Spix and Martius described them as belonging to the Quadersandstein formation† (Upper Cretaceous). By the earlier observers, according to Lyell‡, the stratified portions of this series were supposed to be of marine origin, and were successively referred to the Devonian, Triassic, and Tertiary epochs.

Our own countryman, Henry Walter Bates, who devoted eleven years to the exploration of the natural history of this region, has given us most graphic accounts, in 'the Naturalist on the Amazons,' of the scenery, physical features, &c., but does not dwell much upon its geology.

It was left to Prof. Agassiz, after his visit to Brazil (1865–

* Ansted's Physical Geography, 1867, p. 160.

† Hartt, 'Brazil,' p. 484. ‡ Principles, vol. i. p. 467.